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P031607/WO/1

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Vehicle data bus system having locating means

The invention relates to a vehicle data bus system having locating means which have a locating computing unit and a locating sensor system which contains at least one GPS (Global Positioning System) receiver with associated GPS antenna and gyro data acquisition means, as well as having a data bus via which a plurality of connected bus users have a data transmission connection to one another.

In motor vehicles, use is frequently made of locating means which operate on the basis of the GPS and these are, when necessary, supported by further position-determining means for compound navigation, which can comprise, in particular a gyroscope and an odometer. In addition, a plurality of vehicle-mounted components, referred to below as bus users, which are conventionally first and foremost control devices for performing local vehicle-mounted control functions, are frequently connected to one another via a data bus which can be part of an entire data bus network. Recently, telematics service units are also becoming significant as such vehicle data bus users, said telematics service users having a communications connection, on the one hand, to the "vehicle world" via the vehicle data bus and, on the other hand, to remote stations, which are external to the vehicle, via one or more wireless transmission channels in order, for example, to perform functions such as emergency calls, pursuit of thieves, determination of traffic situation data using sample vehicles etc.

In earlier motor vehicles of this type, the locating

means on the one hand and the data bus with connected vehicle control devices on the other hand formed vehicle subsystems which are separate from one another, and of which frequently also only one of the two was implemented. The locating means themselves frequently were composed of a relatively large number of individual components. The patent US 5.644.317 discloses, for example, an automatic vehicle locating system in which a locating sensor system composed of a plurality of individual sensor units and a locating computing unit to which the output signals of the various locating sensor units are fed are provided in the vehicle. The locating computing unit outputs the data relating to the vehicle position and vehicle situation which are acquired by it to an external unit via a wireless communications channel for presentation of the transmitted position/situation data.

A vehicle-position-determining system disclosed in patent US 5.740.049 determines, by reference to the output signals of a vehicle speed sensor and a gyroscope, a first temporary position information item, corrects it by deriving a second temporary position information item by reconciliation with stored route data and acquires a third temporary position information item from the output signal of a GPS receiver. By evaluating or reconciling the various temporary position information items, a definitive vehicle position is determined and displayed on a screen in a road map view.

The locating means are often an integrated component of a vehicle navigation unit or are connected upstream of it with the sole purpose of supplying the data which is necessary for the navigation and which relates to the position and situation, i.e. orientation, of the vehicle in space and/or of visually displaying the

determined position or situation of the vehicle, see, for example, the laid-open publications EP 0 675 341 A1 and WO 98/36288 A1.

The laid-open application WO 98/10246 A1 discloses a device for recording geographic data which, depending on the configuration, can be determined as a portable device or for installation, in a vehicle, for example, and has not only position-determining means but also video cameras for recording images. A computer unit receives the data which is output by the positioning-determining means and the video cameras and evaluates it to the effect that the direction of the image relative to the device, or the geographic data for an object sensed with the camera can be determined. The device can have a communications connection via a wireless communications channel to a remote station, for example a central processor unit there.

In the laid-open publication DE 196 40 735 A1, a telematics device is described for a motor vehicle which comprises a car radio with an RDS module and a built-in locating system with GPS module, a radio telephone with GSM module, a memory and a display. The RDS module, the GPS module and the GSM module are installed together with a voice unit and the car radio in a housing of the telematics device, the housing having at least antenna terminals for the car radio, the GSM module and the GPS module as well as interfaces for at least one CAN bus and/or one further data bus as well as for at least one loudspeaker and/or a microphone. By means of travel sensors, for example wheel sensors, a direction sensor and/or the GPS module, the position of the vehicle can also be connected and output on a digital map of the visual display. By communicating with a control centre or a navigation system which is built into the telematics

device or a navigation module which can be connected thereto via the CAN bus or the further data bus, it is possible to calculate a desired travel route which is then displayed on the visual display. Via the CAN bus and/or the further data bus, the telematics device can influence an engine control unit which forms a further bus user.

The invention is based on the technical problem of making available a vehicle data bus system of the type mentioned at the beginning which has a convenient locating functionality which can be used in a comparatively flexible way and satisfactorily standardized.

The invention solves this problem by making available a vehicle data bus system having the features of Claim 1. In said claim, the locating means characteristically contain a locating module which is embodied in a specific way as one of the bus users connected to the data bus, in which locating module the components which are used for locating the vehicle are contained largely integrated in one structural unit, the associated locating sensor system being at least partially integrated into the locating module and also connected to the data bus so that the locating module acquires the necessary locating sensor data at least partially in an internal fashion and also receives it via the data bus. Specifically, the locating module contains a locating computing unit which performs the computational determination of a position, and a GPS receiver. Furthermore, it has a gyroscope or means for receiving corresponding gyro data via the data bus from a travel dynamics/traction control system if the latter comprises the respective gyro data acquisition sensor system, as is the case, for example, in some conventional travel dynamics control systems.

As a result of the modular combination and the data bus connection of the locating means, they can be used in a standardized form for different vehicles and in different countries without extensive adaptation measures and make available appropriate locating information on the data bus in a flexible way according to need, from which data bus said information can be called by other vehicle-mounted bus users. The locating information which is made available comprises here, in particular, vehicle position data, direction of travel angle data, travel speed data and altitude position data, i.e. data on the instantaneous altitude position of the vehicle above sea level (NN). A locating precision classification (location quality) in the form of an identifier which indicates the unreliability of the calculated position data is preferably specified for the position data. In order to determine this locating information, the locating module uses not only the gyro data and the GPS data but also wheel speed data and data indicating whether the vehicle is driving forward or backward at a given time, i.e. forward/backward direction of travel data, which it obtains from the data bus. The locating information can be used, in particular for vehicle control units which make use of such information and which have various vehicle-related functionalities such as travel dynamics control, anti-lock brake control, traction control, engine control and gearbox control, by display instruments such as a combination instrument or by a special supplementary information display, but also by communication units which communicate with the vehicle-mounted components via the data bus and with remote components, external to the vehicle, via a wireless communications channel.

In a vehicle data bus system which is developed according to Claim 2, the structural unit which

represents the locating module additionally contains an integrated GPS antenna so that it is not necessary to mount a separate GPS antenna on the vehicle or connect it to the locating module.

In a vehicle data bus system developed according to Claim 3, a navigation unit, which receives the position data from the locating module, is provided as a further bus user. By means of a conventional map-matching process in which this position data is compared with stored travel network data, it acquires improved position information with a new location position classification (location quality). The navigation unit characteristically feeds back the corresponding position correction data via the data bus to the locating module which can use said data for precision-improving correction reconciliation.

In a vehicle data bus system developed according to Claim 4, one or more telematics service units are provided as further bus users, which use the locating data acquired from the locating module, for example for an emergency call function, for the pursuit of thieves and/or for the determination of traffic situations using sample vehicles (what is referred to as a floating car data method).

In a vehicle data bus system developed according to Claim 5, an engine and/or a gearbox control unit is provided as a respective further bus user. The engine and/or the gearbox control unit utilizes the data bus connection, inter alia, to read in the altitude position data made available by the locating module. As a result, it is possible to dispense with an altitude sensor which is conventionally present in modern units of this type.

In a vehicle data bus system developed according to Claim 6, the locating module is part of a further bus user, the locating computing unit being used by this bus user for additional tasks.

Advantageous embodiments of the invention are illustrated in the drawings and will be described below. In the drawings:

Figure 1 shows a schematic partial representation of a vehicle data bus system with locating module with integrated gyroscope and external GPS antenna,

Figure 2 shows a view corresponding to Figure 1 but for a modified data bus system with additional navigation unit,

Figure 3 shows a view corresponding to Figure 2 but for a modified data bus system with a locating module which does not have a gyroscope and which receives gyro data from the bus, and

Figure 4 shows a view corresponding to Figure 2 but for a modified data bus system with GPS antenna integrated into the locating module.

The vehicle data bus system which is illustrated only with its components which are of specific interest here in Figure 1 contains a data bus 1 to which a plurality of bus users are connected, of which bus users a locating module 2 and a telematics service block 3 are shown explicitly, one or more telematics service units for corresponding functionalities, for example emergency calls, pursuit of thieves and the determination of traffic situations using sample

vehicles, being combined by way of simplification in said telematic service block 3. The locating module 2 which is implemented as a component which can be built on in a uniform fashion contains a locating computing unit 2a, a GPS receiver 2b and a gyroscope 2c in an integrated form in this example.

An external GPS antenna 4 which is mounted at a suitable location on the vehicle is connected to the GPS receiver 2b. The locating module 2 is coupled into the data bus 1 via a corresponding bus interface and reads in wheel speed data and forward/backward direction of travel data from said data bus. The wheel speed data can be supplied, for example, in the form of rotational speed sensor pulses per time unit by a travel dynamics/traction control system which also acquires this data for its own use, as is known per se. Here, the travel dynamics/traction control system can be, for example, an anti-lock brake system (ABS) or a travel dynamics control system which is used by the applicant under the abbreviation ESP (electronic stability program). The forward/backward direction of travel data indicates whether the vehicle is travelling forward or backward at a given time, and can originate, for example, from reverse-gear detection means, which determine whether or not the reverse gear is engaged.

If the locating module 2 does not acquire the data necessary for locating from the data bus 1, said data is supplied by the integrated locating sensor units, specifically GPS data of the GPS receiver 2b and gyro data of the gyroscope 2c. The locating computing unit 2a then carries out the actual computational locating process, the term "locating" being used here in a wide sense to the effect that it covers both the determination of the position of the vehicle and its altitude position and orientation in space.

Correspondingly, the locating computing unit 2a determines vehicle position data with its locating precision classification (location quality), direction of travel angle data, travel speed data and altitude position data which indicates the altitude of the vehicle above sea level (NN) at a given time. Furthermore, the locating computing unit 2a contains time-determining means which provide highly precise time information corresponding to a radio clock, the time valid in respective countries being given throughout the world, for example according to the GMT or UTC standard, without the user having to perform complicated menu settings for this purpose. The direction of travel angle data contains not only actual angle information but also offset, drift and scaling factor information.

The locating computing unit 2a feeds this determined, conditioned locating data onto the data bus 1 where it is made available to the other bus users, for example to the telematics service units 3 and/or vehicle control units which are not shown explicitly, for example engine and/or gearbox control unit, which are connected to the data bus 1. A connected engine or gearbox control unit can accept, in particular, the altitude position information made available by the locating module 2 on the data bus 1 and in this way does not require its own altitude sensor. When the system is started, the altitude value which was respectively present last when the vehicle was switched off is expediently used until current altitude position data is available again.

As is apparent from the explanations above, the locating module 2 performs a locating process using a plurality of parallel input information items, specifically the internally acquired GPS data, the

internally acquired gyro data and the wheel speed data received via the data bus 1, which is also used by the locating module 2 to perform an odometer function.

The vehicle data bus system which is illustrated in Figure 2 again merely with its components which are specifically of interest here corresponds essentially to that in Figure 1, corresponding reference symbols being used for functionally identical elements with the exception of the system in Figure 2 contains a navigation unit 5 as a further bus user. The navigation unit 5 receives, via the data bus 1, the various locating data items supplied by the locating module 2 and subjects specifically the received position data to a conventional map-matching process in which the vehicle position determined by the locating module 2 is reconciled with data of a digitally stored travel network map. By means of this process, the navigation unit 5 determines a precise vehicle position, corrected if appropriate, with a new locating precision classification (locating quality) and outputs this and accompanying travel network information, such as names of localities and roads, onto the data bus 1. The bus users connected to the data bus 1 can then use for this purpose the precise vehicle position data made available by the navigation unit 5 if they require vehicle position data. This applies in particular also to the telematics service units 3.

Furthermore, the navigation unit 5 outputs onto the data bus 1 position correction data which represents the possible deviation of the precise vehicle position determined by it from the vehicle position determined by the locating module 2. The locating module 2 can obtain this fed-back position correction data or these correction parameters from the data bus 1 and use them for corresponding correction of the location which it

determines, in order to improve the precision of the position-determining process.

The vehicle data bus system which is again represented in a partial schematic view in Figure 3 corresponds to that in Figure 2, corresponding reference symbols being again used for functionally identical elements with the exception that a modified locating module 2' is used which contains only the locating computing unit 2a and the GPS receiver 2b, but no gyroscope. In this case, the locating module 2' contains means for the bus-end reception and evaluation of gyro data of a travel dynamics/traction control system, e.g. by an ESP controller. This leads to satisfactory results if the gyro sensor means of the travel dynamics/traction control system have an adequate level of precision or efficiency and reliability. The travel dynamics/traction control system makes available the determined gyro data on the data bus 1, from where it can be called by the locating module 2'.

The vehicle data bus system which is illustrated in a schematic partial view in Figure 4 corresponds to that in Figure 2, identical reference symbols being again used for functionally identical elements with the exception that a modified locating module 2" is used which additionally contains an integrated GPS antenna 4a. As a result, the need for a GPS antenna which is to be separately mounted on the vehicle and connected to the locating module is dispensed with.

As the above exemplary embodiments make clear, the present invention implements a vehicle data bus system in which a locating module which is implemented as a stand-alone structural unit, for example in the form of a separate box or plug-in module, is integrated into the bus system as a bus user and contains all the

components which are used for determining locations and receives input information necessary for this purpose via the data bus. The locating module can be used as a small standard box throughout the world in a wide variety of vehicles without extensive adaptation measures. Even without an implemented navigation functionality or emergency call functionality, it is possible to use the location-related services, such as pursuit of thieves, the determination of traffic situations using sample vehicles etc. by means of the locating data supplied by the locating module. The use of the locating data which is made available by the locating module makes the system independent of the manufacturers of communications devices which are used, such as telephone sets. The locating data of the locating module can be used to display the compass direction and/or degrees of longitude and of latitude of the current vehicle position, which can be helpful for breakdown information, for example. Furthermore, a high-precision clock with the display of the time which is currently valid in the respective country throughout the world can be implemented without complicated menu settings by the user. The time can be displayed, for example, in a combination instrument or in an auxiliary heating module, as a result of which the need for a separate clock chip can be avoided. The use of the altitude position information of the locating module by an engine and/or gearbox electronic system makes it possible to avoid the need for a separate altitude sensor. The locating information which is made available by the locating module in a standardized form and which relates to the position, locating precision classification (locating quality), direction of travel angle, direction of rotation, altitude position, inclination of the vehicle, etc. can be used by means of the data bus in a flexible way by the various systems which are based on locating information, for,

for example, emergency calls, calling taxis, navigation, devices which warn of imminent bends, the determination of traffic situations using sample vehicles, travel dynamics control systems, anti-lock brake systems, traction controllers, gearboxes, engine electronic systems, combination instruments and supplementary information.